

FAA Office of Environment and Energy Operations Research Projects

Presented to: JPDO Environmental Working Group
Operations Standing Committee
2009 Annual Workshop

By: Lasantha Wedande
Office of Environment and Energy, AEE-400

Date: July 28-29, 2009



**Federal Aviation
Administration**



Overview

- **Background**
- Operations Research Mission
- Current Operational R&D Projects
- Next Steps



Background: *FAA NextGen Environmental Roadmap*

NextGen Vision

Provide environmental protection that allows sustained aviation growth

5-Pillar Approach to Achieving NextGen Vision/FAA R&D Role

2004 NGATS Integrated Plan & IWP



National Aeronautics R&D Plan



2004 Aviation and the Environment Report to Congress

Better Science & Integrated Modeling

- Tools and Models
- Aviation Emissions Characterization Roadmap
- Aviation Climate Change Research Initiative (ACCRI)
- Noise Research Roadmap
- Airports Cooperative Research Program (ACRP)
- Environmental Management Systems (EMSs)

Accelerate Air Traffic Management Modernization

- Continuous Descent Arrivals (CDA)
- Atlantic Initiative to Reduce Emissions (AIRE)
- Asia and South Pacific Initiative to Reduce Emissions (ASPIRE)
- Advanced clean and quiet procedures
- ACRP

Encourage New Aircraft Technology

- Continuous Low Energy, Emissions and Noise (CLEEN) Program
- NASA Fundamental Aeronautics

Explore Alternative Fuels

- CAAFI
- CLEEN
- ACRP

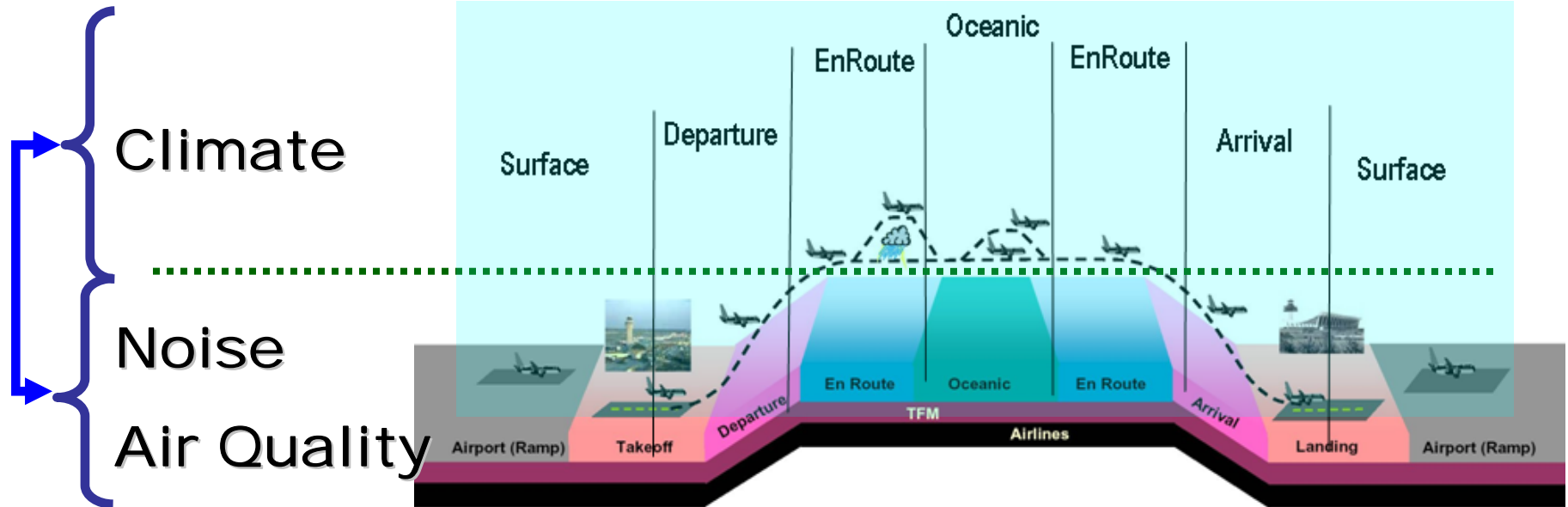
Policy & Market Based Measures

- Environmental Management Systems (EMSs)
- Home Insulation
- Voluntary Airport Low Emissions Program (VALE)
- Land Use

Background: *AEE RE&D Environmental Focus*

IMPACT RELATION

EMISSIONS/NOISE



Drivers

Aircraft & ATM Ops

Energy Consumed

Performance & Efficiency

Technology

Background: *New AEE Division & Attention*

- **A new AEE division** was established in mid-2008: Environmental Policy and Operations Division, AEE-400
- **Responsibilities** include: “Work with AEE divisions and appropriate FAA organizations in coordinating aviation environmental noise and emissions policy and operational initiatives”
- **Goal** is a more systematic approach to address critical environmental operations research needs, including development of a research plan with stakeholders
- **However...**the Division is not fully staffed. Have formed an AEE ops team that is managing a research portfolio



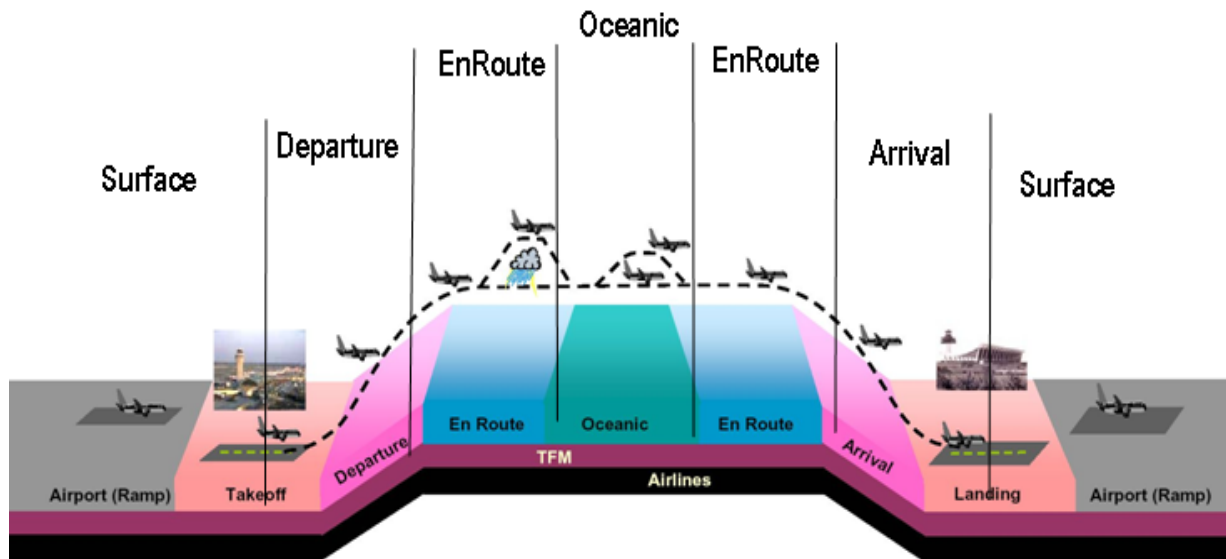
Overview

- Background
- **Operations Research Mission**
- Current Operational R&D Projects
- Next Steps



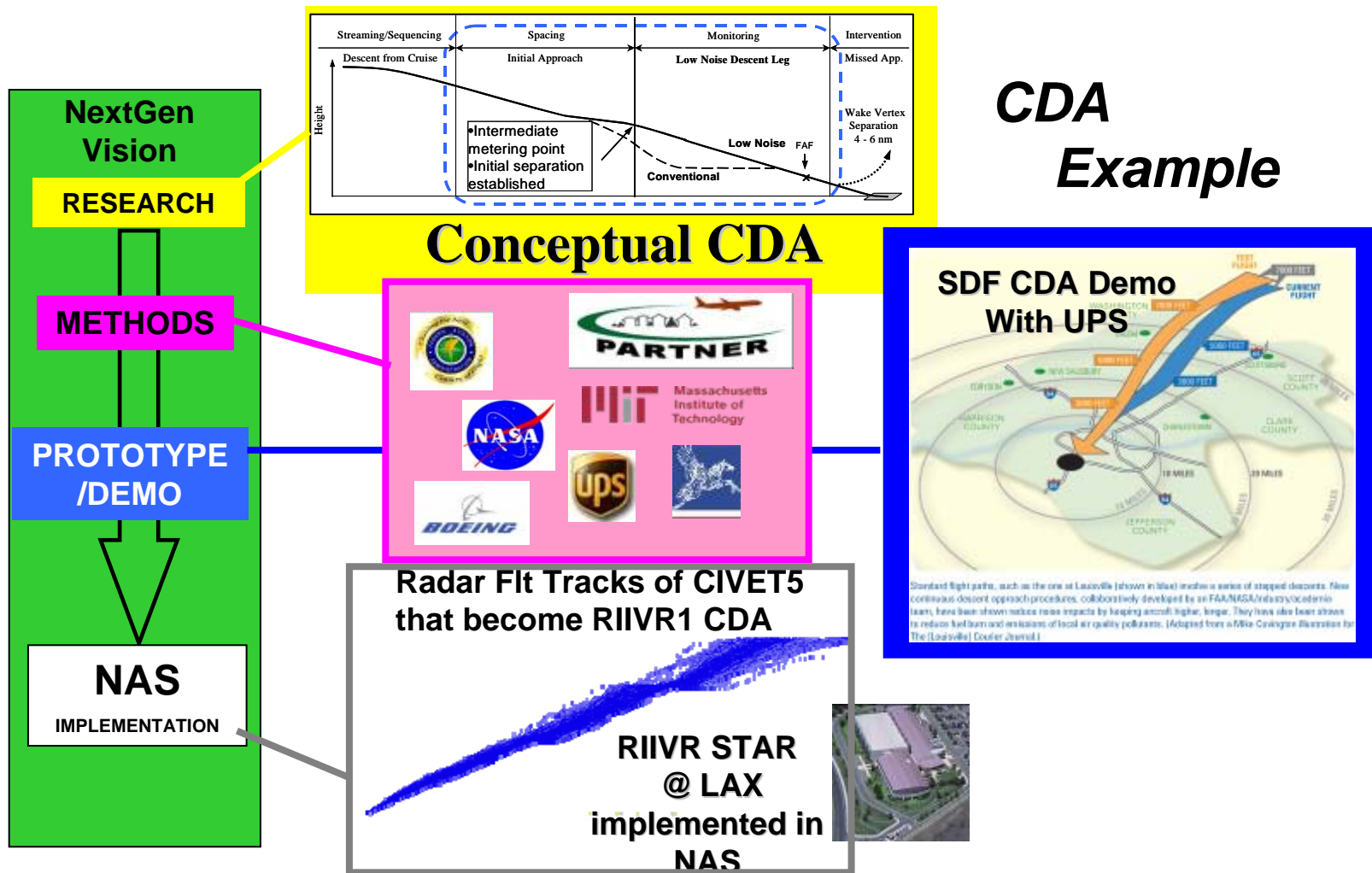
Operations Research Mission: *Focus & Scope*

- **Focus:** Develop and advance operational solutions to enable a balanced approach to environmental and energy improvements for the NextGen system
- **Scope:** Gate-to-gate





Note: Overlaps and interrelationships with noise/emissions mitigation and tools; R&D plans need to be coordinated

Operations Research Mission: *Approach*



Operations Research Mission: *Development*

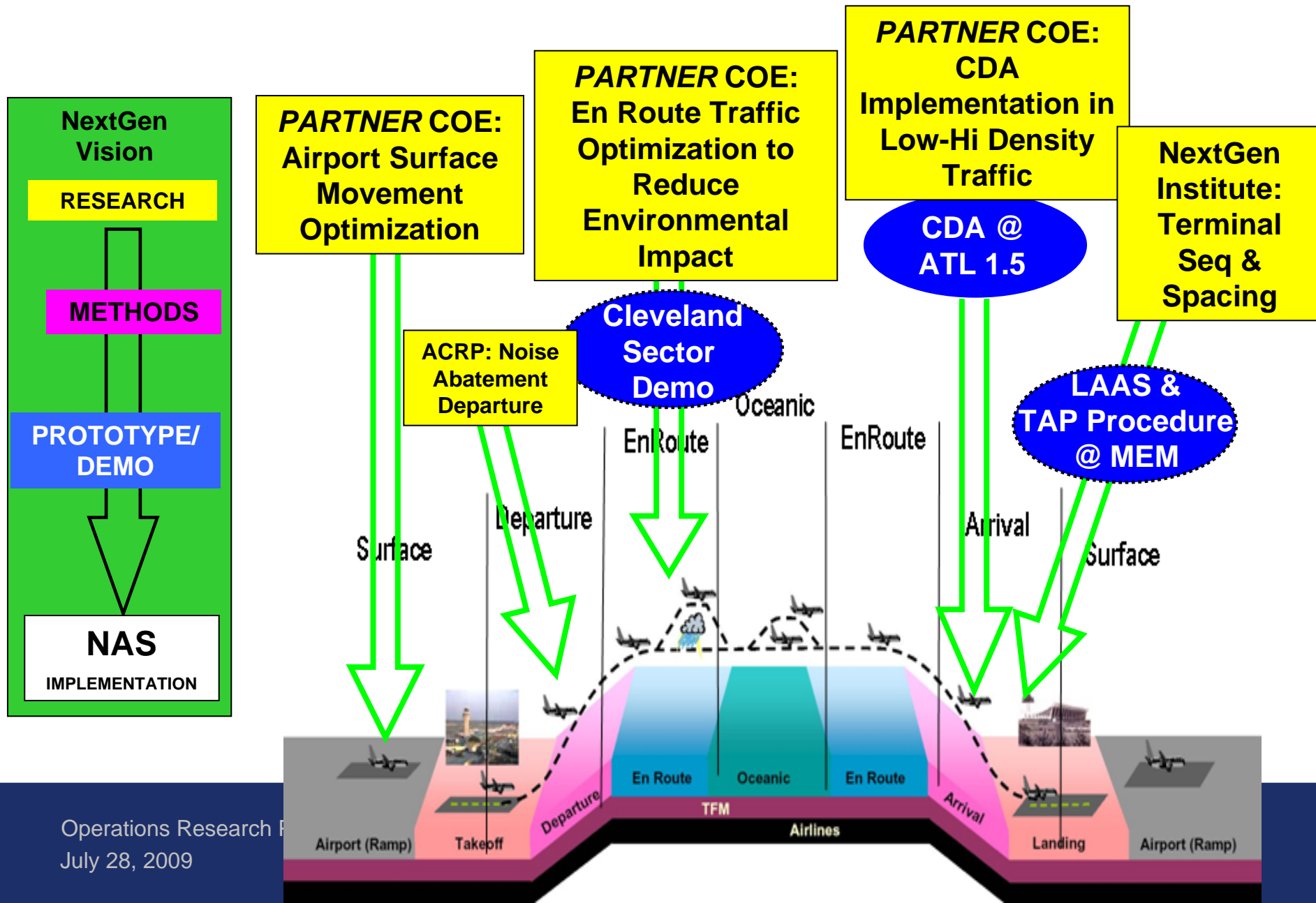
- 
- 
1. Catalogue existing & planned activities and subsequent addition of operations research projects.
 2. Identify gaps and overlaps in research
 3. Draft R&D roadmap
 4. Coordinate with other FAA offices and appropriate external orgs
 5. Refine R&D roadmap
 6. Decide on new FY research projects (2009 projects are already initiated; FY 2010 projects will be decided based on roadmap gaps)

Overview

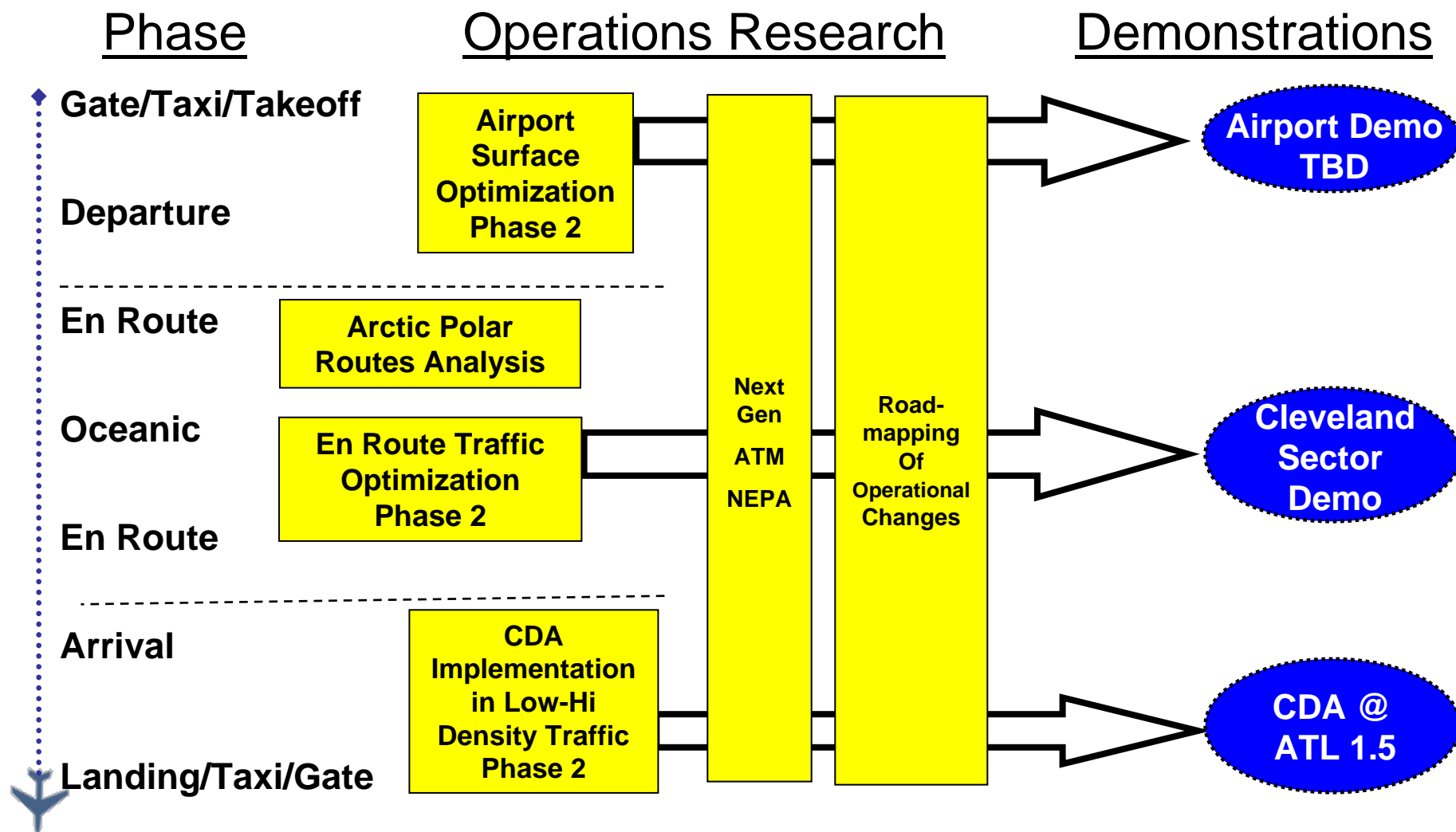
- Background
- Operations Research Mission
- **Current Operational R&D Projects**
- Next Steps



2008-9 Operational R&D: *AEE-Sponsored/Liaison*



2009-10 Operational R&D: *AEE-Sponsored/Liaison*



AEE Operations Research Projects

Project: Roadmapping of Small Operational Changes to Mitigate Environmental Impacts of Aviation

Objective: Systematically evaluate and rank the potential near-term operational changes to reduce the environmental impacts of aviation against a common set of criteria in order to determine the relative potential of each option and to prioritize investments.

Research: Performed through Purdue and MIT.
(1) Identify the comprehensive set of near-term operational environmental impact reduction strategies and first-order estimates of their reduction potential and possible barriers to implementation. (2) Detailed assessment of the most promising opportunities. (3) In collaboration with key stakeholders, some options will be demonstrated in the third stage.

Status: Anticipated start late-Summer 2009

Project: NextGen NEPA Review and Planning for ATM

Objective: Prepare a “roadmap” document for complying with the National Environmental Policy Act (NEPA). Identify potential environmental issues associated with implementing NextGen and recommend the most efficient scale, scope, and process for carrying out the NEPA documentation.

Research: MITRE researchers will be assisting with preparing the “roadmap.” They will identify the best arrangement of environmental reviews, and of process implementation procedures to facilitate NextGen initiatives in complying with NEPA.

Status: Initial contracting paperwork is underway as is coordination with other FAA organizations.

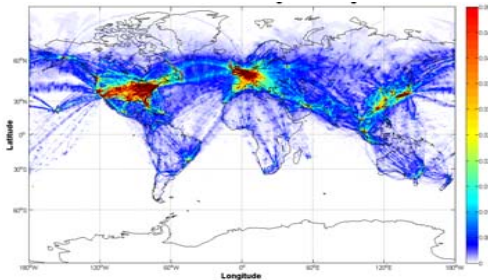
AEE Operations Research Projects

Project: Arctic Polar Circle Flight Rerouting and Climate Impacts Analysis

Objective: Validate climate model indicating proportionally larger impact of aircraft emissions per unit emissions, with respect to the change in surface temperature within the arctic polar region. Develop an emissions inventory for flights above the arctic circle, evaluate reroute options for polar flights and determine net climate impacts.

Research: MITRE and Volpe currently developing an alternative set of flight trajectories for flights above Arctic Circle. Stanford supporting with climate model.

Status: Emissions inventory underway. Candidate flights identified.

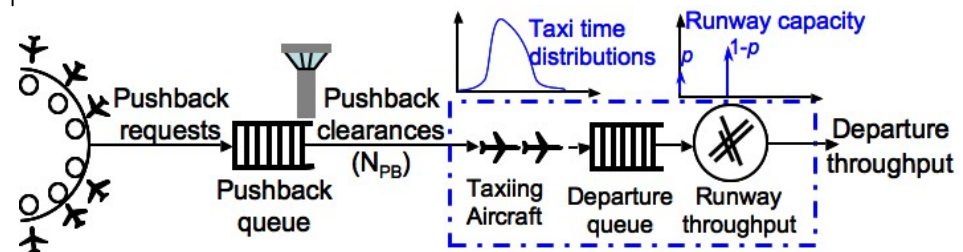


Project: Opportunities for Reducing Surface Emissions through Airport Surface Movement Optimization

Objective: Investigate the reduction of emissions through improved aircraft departure planning and surface traffic movement. Implement and evaluate these techniques in a pilot study at an airport.

Research: MIT researchers currently evaluating N-control gate hold policy to quantify savings in fuel burn, emissions (AQ & GHG) and taxi times

Status: Project kicked off, collaboration with ATO/AJP.



AEE Operations Research Projects

Project: **En Route Traffic Optimization to Minimize Environmental Impact through Reduced Fuel Burn and Emissions**

Objective: Develop an optimization tool to investigate and quantify economic and environmental benefits by assigning aircraft to optimum cruise altitudes and speeds by en-route air traffic controllers, conduct live demo

Research: GTech and FAA researchers developed prototype algorithm, simulated and quantified inefficiencies of current operations, and provided upper bounds on emissions, fuel burn, and throughput benefits

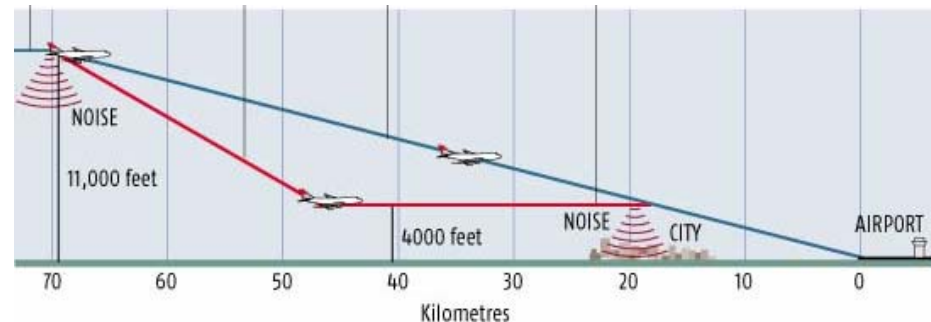
Status: Refine algorithm and explore tradeoff between fairness for specific airlines/aircraft and global optimality for overall benefit of all airlines, as well as a capability of including weather; develop and complete additional simulation studies, and report. Flight demo at ARTCC.

Project: **Continuous Descent Approach (CDA) Implementation in Low-Through High-Density Traffic**

Objective: Develop and prototype candidate procedures and controller tools in support of environmentally optimal approach/arrival procedures for operations within the NAS

Research: MIT Lincoln Labs modeled and optimized separation spacing for CDAs. Demonstration at MEM were successful in spacing aircraft with little intervention from ATL Center and ATL TRACON.

Status: Develop Decision Support Tool for merging two or more streams of traffic



AEE Operations Research Projects

Project: Aircraft Sequencing and Spacing in the Terminal Area Airspace

Objective: Investigate integration of current CNS/ATM technologies to support applications that reduce fuel burn, flight time, emissions and noise, and eliminate terminal area airspace congestion.

Research: Designed Ground Based Augmentation System (GBAS) Terminal Area Path (TAP) procedure and software to support sequencing and optimizing of routes (Identified Navigation System (WAAS or LAAS). Modeled representative flight for baseline and TAP procedure (baseline was an average track from a years worth of ACARS data).

Status: Draft Flight Test and Analysis Plan is Completed and under review.

| Procedure | Parameters | Baseline | TAP | Change | Percent |
|-----------|-------------|----------|-------|--------|---------|
| GILMR | Distance | 52.12 | 61.08 | 8.96 | 17% |
| | Flight Time | 868 | 965 | 97 | 11% |
| | Fuel Burn | 961 | 1040 | 79 | 8% |
| MIOLA | Distance | 69.85 | 73.25 | 3.40 | 5% |
| | Flight Time | 1153 | 1166 | 13 | 1% |
| | Fuel Burn | 1545 | 1417 | -128 | -8% |
| MARVL | Distance | 48.83 | 50.37 | 1.54 | 3% |
| | Flight Time | 810 | 806 | -4 | 0% |
| | Fuel Burn | 892 | 893 | 1 | 0% |
| HOLLI | Distance | 39.26 | 43.87 | 4.61 | 12% |
| | Flight Time | 683 | 762 | 79 | 12% |
| | Fuel Burn | 791 | 848 | 57 | 7% |

Note: Boeing 737-300 aircraft, values are calculated from corner fix and runway threshold. Distance in nm, flight time in sec, fuel burn in lb.



Overview

- Background
- Operations Research Mission
- Current Operational R&D Projects
- **Next Steps**





Next Steps

- **Develop an operations research roadmap in collaboration with stakeholders**
- **AEE goal is a more systematic approach to address critical environmental operations research needs**
- **Continue to build a robust research program**
- **Share research projects with partner stakeholders**
- **Look for collaborative efforts and seek input from stakeholders on proposed research programs**

